Sandia National Laboratories
Waste Isolation Pilot Plant

Analysis Plan for a Panel Closure Design Impact Assessment Study using a Three-Dimensional Grid

AP091

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1.0 INTRODUCTION AND OBJECTIVES

This analysis plan directs the calculations for an impact assessment study on the effects of panel closure design on WIPP performance. The study aims to capture flow field details in the excavated regions and surrounding formations using a three-dimensional (3-D) grid, and thus provide an additional dimension that is not available in the two-dimensional (2-D) BRAGFLO grid used for compliance calculations. The results are thus intended to provide additional information on panel closure design requirements. Results will be compared with those of 2-D calculations. The calculations and analysis will be done in a performance assessment framework, to the quality of a performance assessment. The scope of this study will be Salado flow.

The major objectives of this study are: (1) to provide an evaluation of panel closure design sensitivity on WIPP performance using a 3-D geometry; (2) to compare to results of panel closure impact assessment study using 2-D grid and (3) to utilize a 3-D geometry to verify the accuracy of assumptions made in the 2-D grid. In this study an attempt will be made to study repository performance under tight and loose panel closure (i.e. barrier or no barrier) conditions. The specifics of the various options will be defined during the analysis phase. The study will also attempt to incorporate new material characteristics introduced in the Technical Baseline Migration (TBM) calculations (Stein, 2002; Lord and Hadgu 2002; and Wall, 2001) that were based on most recent observations, measurements and theoretical understanding. The study will also include a comparison of repository performance between the results of the proposed 3-D impact assessment analysis and a new technical baseline.

2.0 APPROACH

This impact assessment study will use the same approach as in previous performance assessment studies. Parameter value input will consist of fixed values or values derived from probability distribution functions (PDF's) [through random sampling or Latin Hypercube Sampling (LHS) of the PDF's], as defined for the Technical Baseline Migration (TBM) calculations (Stein, 2002; Lord and Hadgu 2002; and Wall, 2001). The same random seed will be used as in the TBM (and PAVT), with any new parameters appended so as to allow vector-to-vector comparisons with the 2-D calculations. The analysis approach is briefly summarized below:

2.1 Changes to Panel Closures and DRZ

As stated above, the aim of the new calculations is to evaluate the performance of the repository with different panel closure designs. More specifically, the study will be a repository performance comparison between low and high permeability panel closures (tight and loose barrier). In addition, the accuracy of the 2-D approach will be examined in light of the 3-D

results. The panel closure impact assessment study will also include DRZ changes specified in the TBM calculations.

The study will consist of different panel closure representations, including the panel closure design (Option D), specified by EPA permit (EPA, 1998). Option D panel closure will first be introduced into the 3-D grid, and other changes will then be implemented as desired. Option D consists of a 7.9 m wide concrete barrier, an isolation zone and an explosion-isolation wall. In the 2-D Salado flow grid used for CCA and PAVT calculations, panel closures are represented as 40 m long in the horizontal direction. This is based on an earlier design (see for example WIPP PA, V. 3, 1992). The TBM grid incorporates Option D panel closure by dividing the 40 m length into a concrete part (7.9 m long) and a drift (32.1 m long) (Stein, 2002). In the current study it is proposed to implement the EPA recommended panel closure design into the actual repository space allocated for panel closure (see figures 1 to 4). Thus, the panel closure will be represented by a 7.9 m thick concrete block and by a drift representing the remaining length.

2.2 Numerical Model Grids

Grid modifications represented below in *Task #1* and *Task #2* were introduced in the TBM study. Justification for the changes made can be found in Analysis Plan AP-086 (Stein, 2002). *Task #3* defines the dimensions of the new 3-D grid.

Task #1: Remove shaft from BRAGFLO grids.

The shaft, used in the CCA and PAVT grid, was removed in the new TBM grid. Justification for its removal can be found in Analysis Plan AP-086 (Stein, 2002). The new 3-D grid will also remove the shaft.

Task #2: Modify representation of the DRZ and panel closure used in PAVT calculations.

The panel closure will be divided into a concrete monolith and an open drift as was done in the TBM 2-D grid. The concrete monolith will extend vertically into the DRZ as shown in Figure 4. The DRZ above the concrete panel closure will heal to a value lower than its original permeability when Option D is constructed. The DRZ above waste areas will not be allowed to fracture. Details and numerical values of properties can be found in Analysis Plan AP-086 (Stein, 2002).

Task #3: Construct a 3-D grid.

The 3-D grid will be constructed for the undisturbed repository scenario, and will represent the Salado formation only. The CCA and PAVT calculations showed that the potential release conduits for radionuclides in the undisturbed scenario are vertically through the Shaft and laterally through the anhydrite layers to the Land Withdrawal Boundary. Thus, with the absence

of the shaft, formations above and below the Salado will not be relevant to this study. The grid dimensions will be:

NX = 25, NY = 36 and NZ = 11

Total number of grid blocks = 9900

Figures 1 to 4 show schematic diagrams of the new 3-D grid.

3.0 SOFTWARE LIST

All applicable software and version number are shown in Table 1.

Table 1. Panel Closure Design Impact Assessment Study Software List

CODE	VERSION #
ALGEBRACDB	2.35
BRAGFLO	4.30
GENMESH	6.08
ICSET	2.22
LHS	2.41
MATSET	9.10
POSTBRAG	4.00
POSTLHS	4.07
PREBRAG	6.20
PRELHS	2.30

4.0 TASKS

Teklu Hadgu will handle coordination of the impact assessment study. Scott James, Dave Rudeen and Teklu Hadgu will work on qualification of codes. Steve Tisinger will provide database support. Roger Coman and Marti Hill will execute running of codes in a controlled environment, and storage of data in CMS. The WIPP performance assessment team will provide support in analysis and documentation. The code qualification will be completed by November 1, 2002. Calculation runs, analysis and documentation will be completed by March 31, 2003.

5.0 SPECIAL CONSIDERATIONS

No special considerations have been identified for this study.

6.0 APPLICABLE PROCEDURES

All analyses will be conducted in accordance with the quality assurance (QA) procedures listed below.

1. *Training:* Training will be performed in accordance with the requirements in NP 2-1.
2. *Parameter Development and Database Management*: Selection and documentation of parameter values will use NP 9-2. The parameter database shall be managed in accordance with SP 9-5.
3. *Computer Codes*: Computer codes used in the analyses will be qualified in accordance with NP 19-1.
4. *Analysis and Documentation*: Documentation will meet the applicable requirements in NP 9-1.
5. *Reviews*: Reviews will be conducted and documented in accordance with NP 6-1 and NP 9-1, as appropriate.

7.0 REFERENCES

EPA (U.S. Environmental Protection Agency), 1998. "40 CFR Part 194: Criteria for the Certification and Re-certification of the Waste Isolation Pilot Plant's Compliance with the 40 CFR Part 191 Disposal Regulations: Certification Decision; Final Rule. Federal Register", Vol. 63, No. 95, pp. 27353-27406, May 18, 1998. Office of Radiation and Indoor Air, Washington, D.C.

Lord, D., 2002. "Technical Baseline Migration Analysis Plan". AP-075, Revision 1. Sandia National Laboratories, Carlsbad, New Mexico.

Stein, S. S., 2002. "Analysis Plan for Calculations of Salado Flow: Technical Baseline Migration (TBM)". AP-086, Revision 0. Sandia National Laboratories, Carlsbad, New Mexico.

Wall, D., 2002. "Technical Baseline Migration Analysis Plan". AP-075, Revision 0. Sandia National Laboratories, Carlsbad, New Mexico.

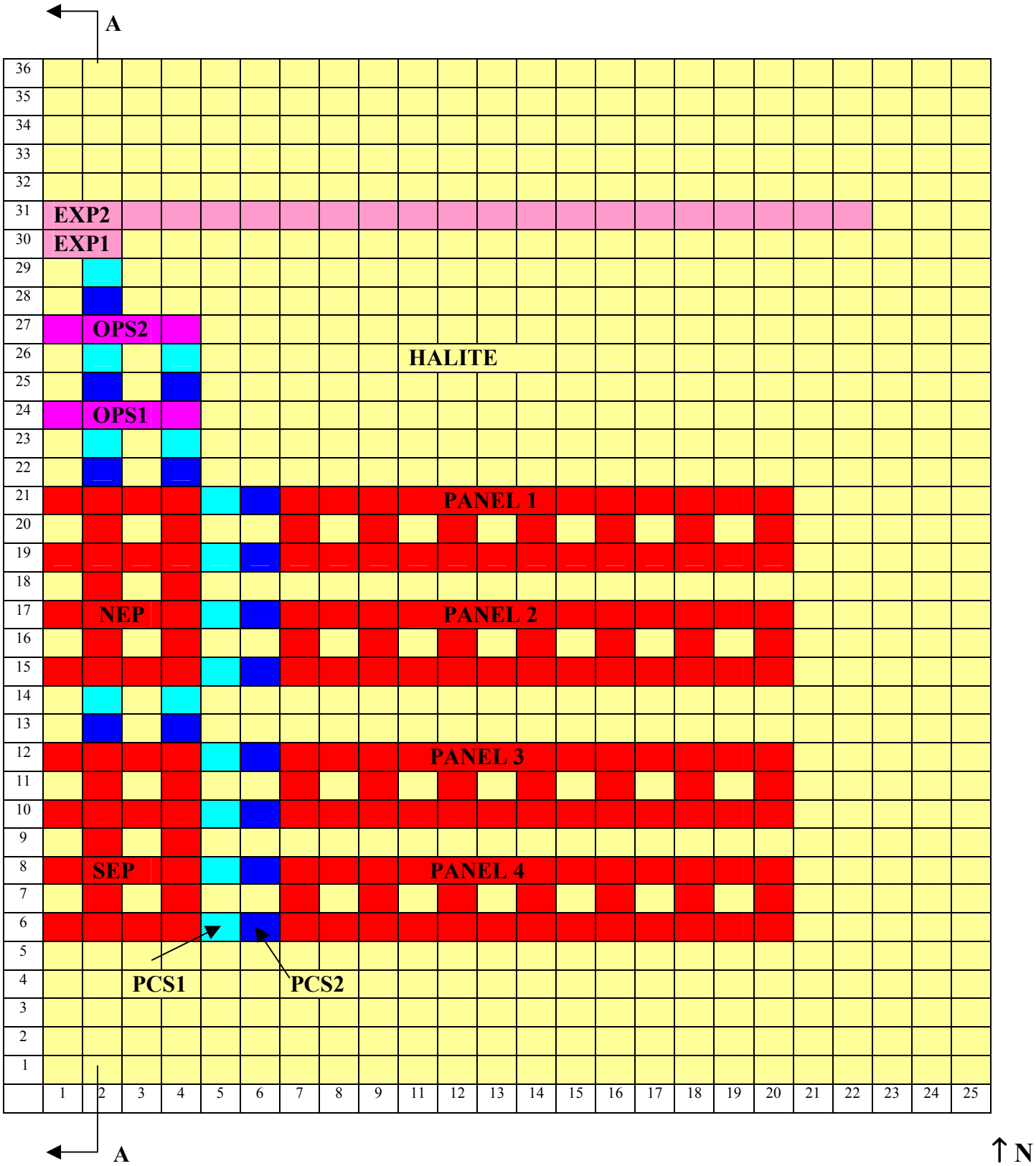

Figure 1: Plan View of 3-D Grid at repository level (Undisturbed Case)

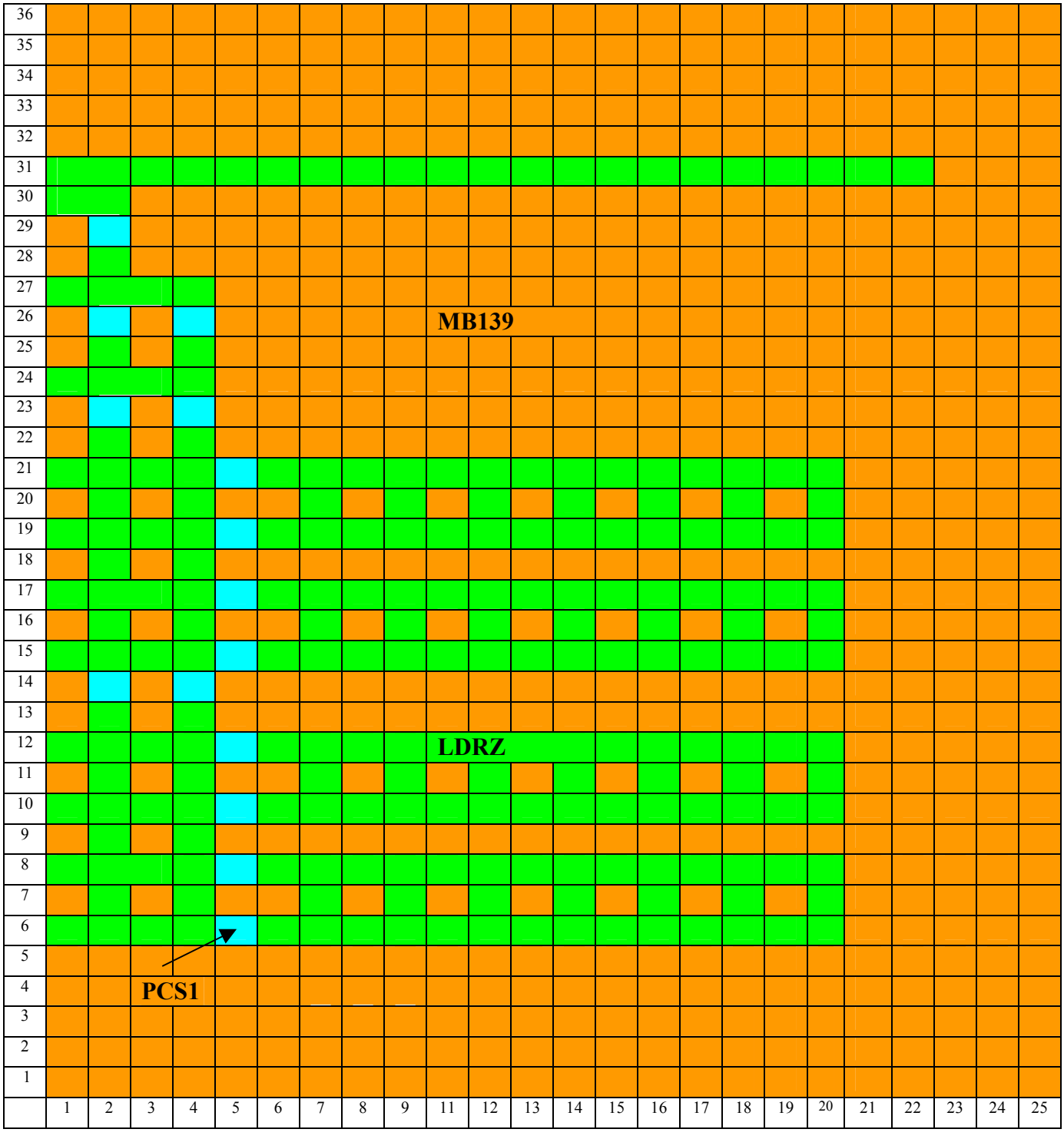

Figure 2: Plan View of 3-D Grid at level of MB139 (Undisturbed Case)

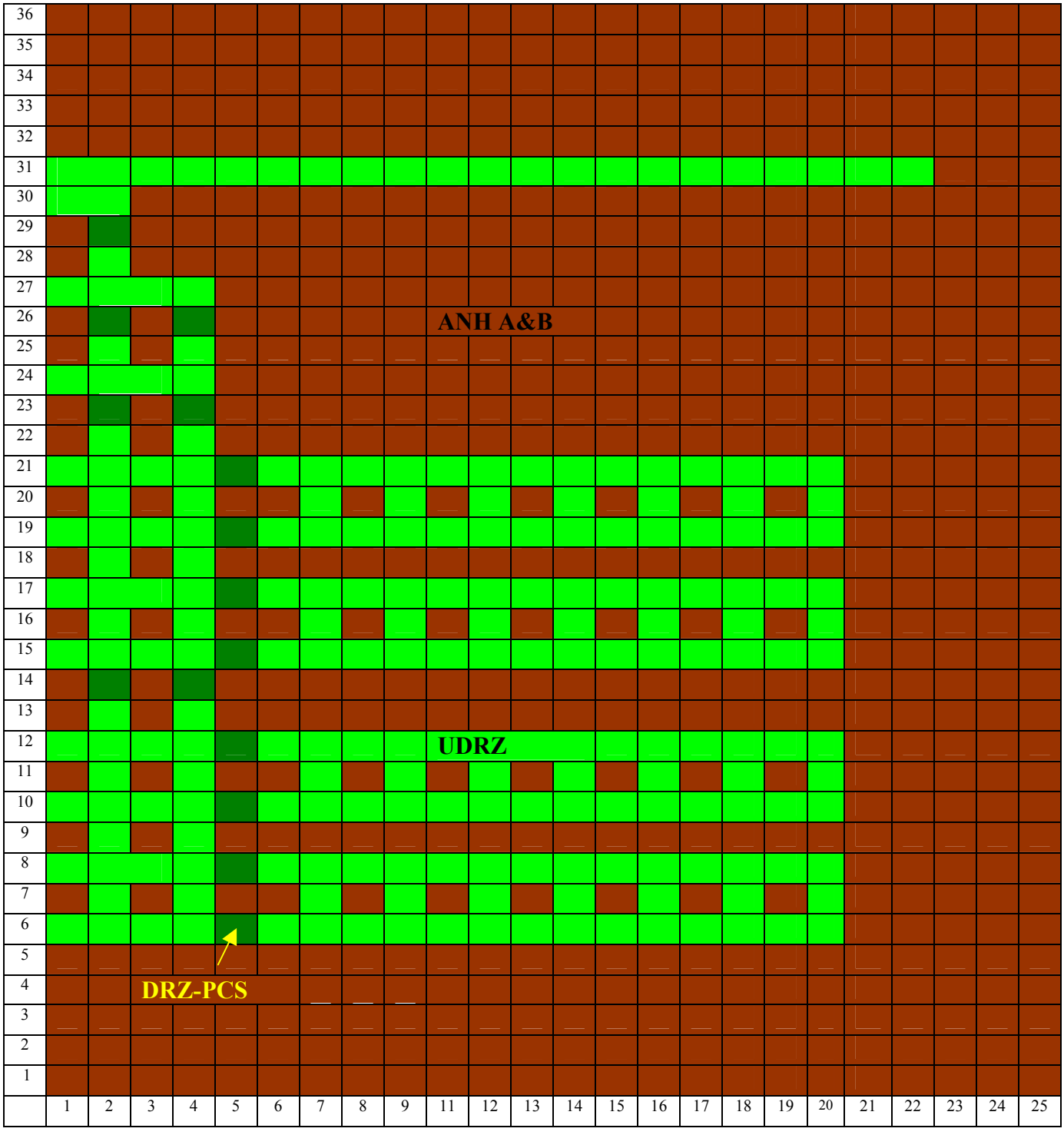

Figure 3: Plan View of 3-D Grid at level of Anhydrite A&B (Undisturbed Case)

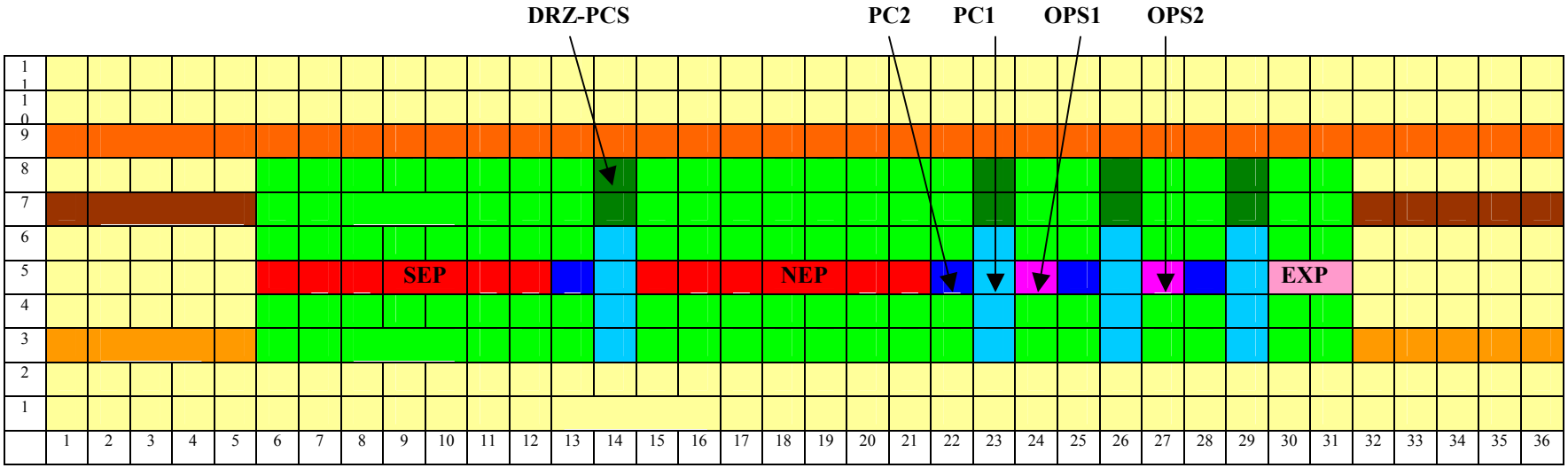

Figure 4: A Vertical North-South Cross-Section of the Three-Dimensional Grid (Undisturbed Case) → N
(See Cross-Section AA in figure 1)